

This listing of claims will replace all prior versions, and listing, of claims in the application:

Listing of Claims:

1. (Currently Amended) ~~A wiring connection structure for a printed circuit board~~ having a wiring connection structure for interconnecting wiring circuit traces on a plurality of circuit trace layers applied on a plurality of printed circuit board layers and electrically isolated there between by the printed circuit board layers and having a printed circuit board multi-layer structure, characterized by:

a through hole ~~with a convoluted~~ having a non-circular shaped cross section normal to a longitudinal axis of the through hold and having an interior wall that vertically extends through and intersects and exposes ~~a plurality of~~ at least two wire circuit traces and having a plating of conductive material applied to the interior wall electrically connecting ~~a plurality of wire exposed~~ the at least two wire circuit traces ~~on a plurality of circuit layers.~~

2. (Currently Amended) ~~An EMI shielding structure for a~~ A printed circuit board having an EMI shielding structure for shielding wiring circuit traces on a plurality of circuit trace layers applied on a plurality of printed circuit board layers and electrically isolated there between by the printed circuit board layers and having a printed circuit board multi- layer structure, characterized by:

a trench having a rim about an opening of the trench at a top printed circuit board layer and said trench extending through a plurality of printed circuit board layers to a grounding plane exposing said grounding plane and said trench having an interior wall with a conductive plating material applied over said interior wall and said trench having a length greater than two times a breadth of said trench and ~~said wall vertically~~ wherein the trench extends completely around the ~~perimeter~~ an area of the printed circuit board and wherein said conductive plating material electrically connects to said exposed ~~ground~~ grounding plane ~~and wraps over~~ ~~and laterally extends from said rim forming a lip.~~

3. (Currently Amended) ~~A wiring connection structure for a printed circuit board~~ having a wiring connection structure for interconnecting ~~a plurality of wiring~~ at least two wire traces ~~applied on a plurality of printed circuit board layers and electrically isolated by printed circuit board layers and having a printed circuit board first layer with a main surface~~ therein, characterized by:

a first wire trace applied to ~~said~~ a main surface of a printed circuit board layer and having a first terminal landing pad with a first through hole there through, said first through-hole having a non-circular shaped cross section normal to the longitudinal axis of the first

through hole ~~with a continuous perimeter~~ and having an inner wall;

a ~~printed circuit board~~ first insulation layer formed over said first wire trace having a second through hole of identical cross sectional geometry to and vertically aligned with the first through hole and ~~extending to the first terminal landing pad exposing a portion of said first landing pad~~ and the second through hole having an inner wall; and

a second wire trace applied to the ~~printed circuit board~~ first insulation layer having a second terminal landing pad with a third through hole having identical geometry to and vertically aligned with the first ~~and second through holes~~ hole and the third through hole having an inner wall; and

wherein ~~said first, second and third through holes are adjoining and are plated there through~~ the inner wall of the first through hole, the inner wall of the second through hole, and the inner wall of the third through hole are plated with an electrically conductive material forming a plated through hole with a non-circular shaped cross section that vertically intersects the first and second terminal pads and electrically connects the first wire trace and the second wire trace ~~by a connection between the first and second wire trace terminal landing pads and the plated through hole.~~

4. (Currently Amended) The ~~wiring connection structure~~ printed circuit board of claim 3, wherein the ~~first through hole has a shaped continuous curved cross section centered on a circumference diameter of a standard single diameter circular profile micro via and wholly contained within a perimeter defined by the circumference diameter~~ non-circular shaped cross section of the plated hole is irregular.

5. (Currently Amended) The ~~wiring connection structure~~ printed circuit board of claim 4 3, wherein the ~~continuous curved~~ non-circular shaped cross section of the plated hole is "U" shaped.

6. (Currently Amended) The ~~wiring connection~~ printed circuit board of claim 4 3, wherein the ~~continuous curved~~ non-circular shaped cross section of the plated hole is "L" shaped.

7. (Currently Amended) The ~~wiring connection~~ printed circuit board of claim 4 3, wherein the ~~continuous curved~~ non-circular shaped cross section of the plated hole is "+" cross-shaped.

8. (Currently Amended) The ~~wiring connection structure~~ printed circuit board of claim 3, wherein the first through hole has a shaped continuous curved

cross section centered on a circumference diameter of a standard single diameter circular profile micro via and is wholly contained within or extends beyond the perimeter defined by the circumference diameter.

9. (Currently Amended) ~~A reference plane structure of a printed circuit board~~ having a reference plane structure for fixing a potential reference for a plurality of wiring circuit trace layers that are electrically isolated there between by a plurality of printed circuit board layers and having a printed circuit board ~~first~~ layer with a main surface, characterized by:

a ~~first~~ wire trace circuit layer applied to said main surface;

a ~~first~~ printed circuit board ~~insulating~~ board-insulation layer formed over said ~~first~~ wire trace circuit layer;

a ~~first~~ reference plane applied over the ~~first~~ printed circuit board insulation layer;

a trench having an interior wall ~~and extending about a perimeter encompassing the first wire trace circuit layer and extending through the printed circuit board first layer,~~ extending through and exposing the ~~first~~ wire trace circuit layer, and the trench further extending through the ~~first~~ insulation layer ~~and extending to the reference plane exposing said~~ wherein the reference plane is exposed; and

a conductive plating layer on the interior wall electrically ~~connecting~~
connects the ~~first~~ wire trace circuit layer to the ~~grounding~~ reference
plane.

10. (Currently Amended) ~~The reference plane structure~~ printed circuit board
of claim 9, ~~where~~ wherein the ~~perimeter~~ trench completely encompasses a
~~portion of the first~~ wire trace circuit layer.

11. (Currently Amended) ~~The reference plane structure~~ printed circuit board
of claim 9, ~~where~~ wherein the reference plane is fixed at a ground potential.

12. (Currently Amended) ~~The reference plane structure~~ printed circuit board
of claim 9, ~~where~~ wherein the reference plane is fixed at a reference voltage.

13. (Currently Amended) ~~A wiring connection structure for a printed circuit~~
~~board~~ having a wiring connection structure ~~for interconnecting a plurality of~~
~~wiring circuit traces applied on a plurality of printed circuit board layers and~~
~~electrically isolated by printed circuit board layers and having a first printed~~
~~circuit board layer with a main surface, characterized by:~~

a first wire ~~circuit~~ trace having a width and applied to ~~said~~ a main surface
of a printed circuit board layer and having a first terminal landing

~~pad with a terminal width the same as the width of the first wire~~
~~trace and having a first through hole having a non-circular cross~~
~~section taken normal to a longitudinal axis of the first through hole~~
~~and having an inner wall~~ and with a major diameter and a minor
diameter ~~where~~ wherein the minor diameter is less than the width
of the first wire trace and the major diameter is elongated and
~~directional~~ oriented along a longitudinal direction of the first
terminal landing pad;

a ~~printed circuit board~~ first insulation layer formed over said first wire
trace and having a second through hole having an inner wall and
having identical geometry and orientation as the first through hole
and vertically aligned with the first through hole ~~and extending to~~
~~the first wire trace terminal landing pad~~; and

a second wire ~~circuit~~ trace applied to the ~~printed circuit board~~ first
insulation layer and having a second terminal landing pad ~~with~~ and
having a third through hole having an inner wall and having
identical geometry to the first through hole and aligned with the
first through hole, and

wherein ~~said first, second and third through holes are adjoining and are~~
~~plated there through~~ the inner wall of the first through hole, the
inner wall of the second through hole, and the inner wall of the

~~third through hole are plated~~ with an electrically conductive material forming a plated through hole which vertically ~~intersecting~~ intersects the first terminal pad and second terminal ~~pads~~ pad and electrically ~~connecting~~ connects the first wire trace and the second wire trace ~~by a connection between the first and second landing pads and the through hole.~~

14. (Currently Amended) The ~~wiring connection structure~~ printed circuit board of claim 13, wherein the major diameter is at least ~~7~~ about twice that of the minor diameter.

15. (Currently Amended) The ~~wiring connection structure~~ printed circuit board of claim 13, wherein the major diameter is at least about three times that of the minor diameter.

16. (Currently Amended) A ~~wiring connection structure for a printed circuit board~~ having a wiring connection structure for interconnecting a plurality of ~~wiring circuit traces applied on a plurality of printed circuit board layers and electrically isolated by printed circuit board layers and having a first printed circuit board layer with a main surface,~~ characterized by:

a first wire ~~circuit~~ trace having a first width and applied to said a main

surface of a printed circuit board layer and having a first terminal landing pad ~~with~~ having a second width which is greater than the first width and having a first through hole having a non-circular cross section taken normal to a longitudinal axis of the first through hole and with having an inner wall and with a major diameter and a minor diameter and wherein the minor diameter is less than the second width and wherein the major diameter is greater than the first width and is ~~directed~~ oriented along ~~and~~ a longitudinal direction within the first terminal landing pad;

~~a printed circuit board first~~ an insulation layer formed over said first wire trace and having a second through hole ~~of~~ having an inner wall and having identical geometry and orientation as the first through hole and vertically aligned with the first through hole ~~and extending to the first wire trace terminal landing pad;~~ and

a second wire circuit trace applied to the ~~printed circuit board first~~ insulation layer and having a second terminal landing pad ~~with~~ and having a third through hole having identical geometry to the first through hole and aligned with the first through hole, and wherein ~~said first, second and third through holes are adjoining and are plated~~ the inner wall of the first through hole, the inner wall of the second through hole, and the inner wall of the third through hole

~~are plated~~ with an electrically conductive material forming a plated ~~through hole~~ which vertically ~~intersecting~~ intersects the first terminal pad and second terminal ~~pads~~ pad and electrically ~~connecting~~ connects the first wire trace and the second wire trace ~~by a connection between the first and second landing pads and the through hole.~~

17. (Currently Amended) A method of interconnecting a plurality of ~~wiring circuit~~ wire traces applied on a plurality of printed circuit board layers ~~and electrically isolated by printed circuit board layers~~ characterized by the steps of:

applying a first wire trace to a main surface of a first printed circuit board layer ~~where~~ wherein said first wire trace has a first terminal landing pad;

~~forming a first printed circuit board~~ an insulation layer over said first wire trace;

applying a second wire trace over the ~~first~~ insulation layer, said second wire trace having a second terminal landing pad vertically aligned over the first terminal landing pad;

~~cutting with a cutting means vertically down~~ through the first terminal landing pad, the insulation layer, and the second terminal landing pad ~~removing away material about an axial centerline of the cutting~~

~~means with a generally circular patterned cutting action;~~
~~translating the cutting means laterally while continuing the circular~~
~~patterned cutting action forming a non-circular through hole~~
~~through the first and second pads and the insulation layer to define~~
~~an interior wall and exposing the first and second terminal pads~~
~~forming a hole there through having a non-circular shaped cross~~
~~section, the hole having an interior wall; and~~
plating the interior wall of the hole with an electrically conductive
material, ~~thereby~~ electrically connecting the first wire trace and
second wire traces trace by the connection established between the
first terminal landing pad and second terminal landing pads ~~and the~~
~~electrically conductive material plating pad.~~

18. (Currently Amended) The method of interconnecting a plurality of wire traces of claim 17, wherein in the cutting is step, the cutting is by plasma ablation.

19. (Currently Amended) The method of interconnecting a plurality of wire traces of claim 17, wherein in the cutting is step, the cutting with a is by laser processing.

20. (Currently Amended) A method of grounding and shielding a plurality of ~~wiring circuit~~ wire traces applied on a plurality of printed circuit board layers ~~electrically isolated by a plurality of printed circuit board layers~~ characterized by the steps of:

applying a ~~first wire circuit~~ trace to a main surface of a ~~first~~ printed circuit board layer ~~said first wire trace having a first ground terminal lead~~;
forming a ~~first printed circuit board~~ an insulation layer over said ~~first~~ wire trace;

applying a grounding plane over the ~~first printed circuit board~~ insulation layer;

cutting ~~vertically down~~ through the ~~first~~ printed circuit board layer and the ~~first~~ insulation layer ~~removing away material an axial center line with a generally circular patterned cutting action with a cutting means transcend the first wire trace and extend to the grounding plane~~;

~~translating the cutting means laterally while continuing the circular patterned cutting action~~ thereby forming a trench ~~extending to form a perimeter at least partially about the first wire trace, the trench~~ having an interior wall exposing the ~~first ground terminal lead~~ wire trace and the ~~ground~~ grounding plane; and

plating the interior wall of the ~~trenched through hole~~ trench with an

electrically conductive material ~~electrically~~ thereby connecting the first wire trace to the grounding plane.

21. (Currently Amended) ~~An EMI shielding structure for a~~ A printed circuit board having an EMI shielding structure for shielding a plurality of wire circuit trace layers ~~that are electrically isolated by printed circuit board layers,~~ characterized by:

a printed circuit board layer having a ~~plurality of wire trace circuit layers~~ applied thereto; ~~and a plurality of printed circuit board insulation layers there between and having a plurality of printed circuit board edges~~

an insulation layer; and

a grounding plane; ~~and~~

a first trench having an interior wall and ~~extending in parallel with the board edge within a~~ forming a perimeter defined by the board edge encompassing the ~~printed circuit board~~ wire circuit trace and extending through the printed circuit board ~~layers~~ layer and extending to the ground plane; and exposing said ground plane; and

an electrically conductive plating material applied ~~over~~ upon the interior wall ~~there through~~ of the first trench and electrically connecting to

the exposed ground plane providing ~~at least a partial~~ a perimeter shield for the ~~printed circuit board~~ wire trace.

22. (Cancel)

23. (Currently Amended) The ~~EMI shielding structure~~ printed circuit board of claim 21, further characterized by:

a second trench having an interior wall and ~~extending wholly within and in parallel with an outer perimeter defined by the first trench~~ spaced a distance from the first trench such that the wire trace extends between the first trench and second trench, the second trench ~~and extending through the printed circuit board layers~~ layer and extending to the ground plane exposing said ground plane, wherein the interior wall of the second trench ~~interior wall~~ is plated with an electrically conductive plating material ~~applied over the interior wall there through and~~ electrically connecting to the exposed ground plane thereby providing a double trench shield.

24. (New) The printed circuit board of claim 21, further characterized by:
an EMC sensitive track of conductive material extending wholly within a perimeter defined by the first trench and disposed between a

plurality of circuit board insulation layers through which the first trench extends.

25. (New) A printed circuit board having an EMI shielding structure for shielding a plurality of wire trace layers, characterized by:

a plurality of printed circuit board layers having a plurality of wire trace layers, each printed circuit board layer separated by an insulation layer and having a grounding plane layer;

a first trench extending from a top printed circuit board layer to the grounding plane layer and the first trench having;

an electrically conductive plating applied over an interior wall of the first trench and electrically connecting to the ground plane; and wherein the first trench completely surrounds at least an area of the printed circuit board layers.

26. (New) The printed circuit board of claim 25, further characterized by:

a second trench disposed interior to the first trench and said second trench extending substantially in parallel to the first trench;

and the second trench having an electrically conductive plating applied over an interior wall thereof electrically connecting to the ground plane and an EMC sensitive track extending in a printed circuit

board layer positioned between the first trench and the second trench.

27. (New) The printed circuit board of claim 3 comprising at least a second plated through hole, the second plated through hole having a non-circular cross section which is different from the non-circular cross section of the first plated through hole.

28. (New) The printed circuit board of claim 3 wherein the non-circular shaped cross section of the through hole is a cross, a "U", an "L", an "E", a square, a rectangle, a "double cross", a star, an oval, a continuous curve, or an irregular shape.

29. (New) The method of claim 17 wherein the non-circular shaped cross section of the through hole is a cross, a "U", an "L", an "E", a square or rectangle, a "double cross", a star, an oval, a continuous curve, or an irregular shape.

30. (New) A printed circuit board having an EMI shielding structure for shielding a plurality of wire trace layers, characterized by:

a plurality of printed circuit board layers having a plurality of wire trace

layers, each printed circuit board layer separated by an insulation layer and having a grounding plane layer;

a first trench extending from a top printed circuit board layer to the grounding plane layer and the first trench having an electrically conductive plating applied over an interior wall of the first trench and electrically connecting to the ground plane; and

a second trench disposed interior to the first trench and said second trench extending substantially in parallel to the first trench and the second trench having an electrically conductive plating applied over an interior wall thereof electrically connecting to the ground plane; and

at least two EMC sensitive tracks extending in a printed circuit board layer positioned between the first trench and the second trench.